A Personal Study of Agriculture & Natural Resources in Peru

An Honors Thesis (HONRS 499)

by

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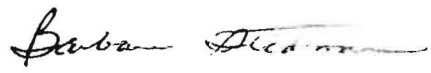

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Abstract:

Natural resources, and the agricultural systems that are based on them, have long been Peru's blessing as well as the cause of much of the country's bad fortune. Peru is the place of origin for several of the world's most important crops, including the tomato and the potato. It also enjoys one of the highest levels of biodiversity in the world, as well as a variety of valuable minerals. These resources helped lead to the great achievements of the Incan empire but also to its collapse at the hand of the Spaniards who came looking for those same resources. It was for these reasons that I, as a student of natural resources and environmental management, a field that intimately ties scientific processes with human behavior, chose to study in Peru for two semesters in 2010. The following reflects on agriculture and natural resources in Peru as I experienced them, tying traditional research with personal anecdotes to find a balance somewhere between research paper and memoir.

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Furthermore, I would like to thank Gabriel Peña Cuellar for his continuous help and tolerance in my pursuit to understand Peru's agriculture during my time in the country as well as after I left, and also for the use of his photos.

Map 1. Geopolitical map of Peru (Source: peru.org.pe)

transportation obstacles that various regions of the country face, and the impact that education and gender roles can have. I explore Peru's most controversial natural resources, water and coca, as well as its most basic, the potato, and how they affect the relationships between different cultural and class groups, as well as Peru's international relations. Furthermore, I discuss a variety of factors that affect Peru's current state of agriculture and natural resources, including gender roles, globalization, and education.

To give a little background, in 2009 I was awarded the Boren Scholarship, a US federal scholarship that funds language study in a country where students do not normally study abroad. And while this feature does not specifically pertain to me and my Spanish study, its focus is in languages that most Americans do not speak. For me personally, being awarded the Boren Scholarship meant I took a year off in the middle of my senior year. I completed the first semester of that year at Ball State in the fall of 2009, left for Peru in January 2010, and returned to finish my degree a year later in January 2011. My study in Peru was separated into two parts: the first in which I studied Spanish and did volunteer work with an American-based non-profit organization, ProWorld, and the second, in which I directly enrolled in the agronomy college at the National University of San Antonio Abad of Cusco, the city where I lived.

II | Agriculture

To tell my story of agriculture in Peru, it might be easier if I start with my story of agriculture before Peru. It is a very brief story. Like many others from my generation, I spent my childhood and teenage years at soccer practices, piano lessons, student council meetings, and theater dress rehearsals. This schedule left little time for me to have any interaction with the food I ate, as my mother did virtually all of the cooking in our family. I had even less interaction with the source of that food. Granted, I had spent afternoons at my grandparents' house, squishing the potato bugs that plagued their garden

plot – I have a clear memory of the orange stain their guts left on my fingertips. But other than that I was disconnected from the long process of growing, harvesting, processing, and preparing food. I was familiar only with the last step in that process, the one in which I stuck the food with a fork and put it in my mouth.

It was not until college that I became interested in the whole process of food, from seed to plate. I had my first attempt at growing food in the summer between my junior and senior year. I grew tomatoes, beans, peppers, and lettuces in containers on my front porch and celebrated when I got to the end of August and had things to eat that I had seen from their beginning as seeds.

It was with this very limited experience that I found myself aboard a plane to Peru in January of 2010 to study agriculture. Even then I was not involved in the agricultural process I had become so interested in until July of that year when I started my second semester at the National University of San Antonio Abad. I spent my first five months studying Spanish with the American-based volunteer organization ProWorld so that I could communicate with my Peruvian classmates in my second semester. Those classmates teased me, good-naturedly, about my blisters, telling me that my delicate American hands wouldn't be able to do the same work that theirs could. I protested weakly, but it was true. Not only was the actual work difficult; the learning curve was steep for me. But through the process I learned a lot about the reality of agriculture in Peru and how the line that separates a country like the United States from a country like Peru is easy to quantify but harder to understand until you have actually seen and experienced it.

In this first half, I will discuss agriculture in Peru, how it has developed and where it still has to go. It should be clarified that agriculture is incredibly varied throughout the country, from the relatively mechanized coast to the more remote mountain and rainforest regions. I travelled through parts of the coast and rainforest, but my personal experience mostly was in the mountainous region of Cusco

in southern Peru and therefore my perspective mostly reflects that area. The contributing factors to the current agricultural state of Peru are wide and varied, but mechanization, transportation, gender roles, and education all have a role.

Mechanization

When discussing any nation-wide issue in Peru, mechanization included, its geography needs to be taken into consideration. Peru is incredibly diverse geographically, but generally split into three regions: the coast, the sierra (mountains), and the selva (rainforest). The coast is where the capital, Lima, is located, home to over half of the country's population, and is by far the most developed of the three regions. The sierra and the selva are developing, the sierra faster than the selva, but parts of

Photo 1. Farming in the sierra is generally characterized by small low-technology plots

I distinctly remember sitting in a green-upholstered chair in the office, looking distractedly at the Christmas decorations that were still up in June on the 1970s-style, wood-paneled walls, listening to Jay-Z commemorate New York City in his most recent top 40 hit. I had come to the agronomy academic office at the San Antonio Abad National University of Cusco for the third time that week with the intention of *getting to the bottom of this*: signing up for classes. The other two times I had come that week (as well as the three I had come the week before), I had been told that they couldn't do that today, no, come back tomorrow, no, better come back the day after that. Or better yet, go to the other office on the main campus; they're really the ones who should help you with that. I felt as though I had spent weeks shuttling between the university's main campus and the agronomy campus, which was located a 40-minute bus ride down the road, listening to people tell me I was in the wrong place. I was pretty sure I was becoming known as that tense-looking white girl with lilted Spanish who kept pestering them for course lists and schedules and maps. Now I think to myself, *If only I could do that semester over again, I would do it right.*

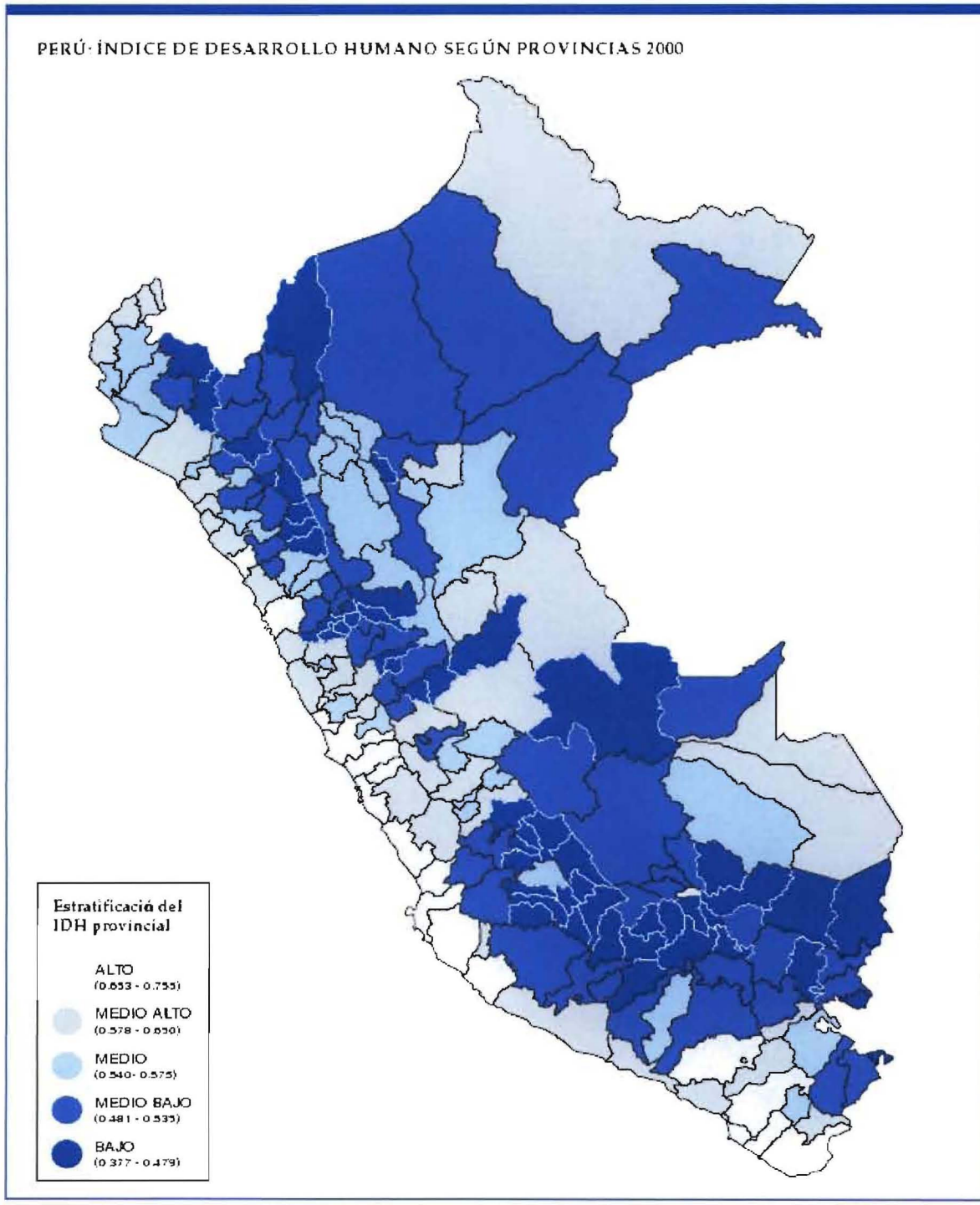
If I learned anything through this experience, it is that if you push the system, the system pushes back. Peru does have a structure, and a decidedly un-American one at that, and if you're a foreigner and you try to point out the glaring mistakes, you generally get laughed at. I got very accustomed to being laughed at, and to laughing at myself. The system often doesn't make sense, but it also often works. And if you let yourself stop pushing, and instead just slide into it, things will usually turn out for the best.

This project, a marriage between research paper and reflection, explores the current state of agriculture and natural resources in Peru as I experienced them in my eleven months in the country. It discusses the slow process of mechanization that the country's agriculture is undergoing, the

both remain incredibly isolated. Accordingly, Peru's various regions have a wide span of agricultural technology, from relatively sophisticated on the coast to minimal in the sierra and the rainforest.

The arid coast is environmentally unsuitable for extensive agriculture, as the coastal provinces receive an average of only 40 millimeters of rainfall a year (Food and Agricultural Organization , 2000). Paradoxically, it is also where virtually all of Peru's commercial agriculture takes place. Keeping this fact in mind, as well as the maxim that necessity is the mother of invention, it is not surprising that the coast is the most technologically sophisticated region of the three. Furthermore, it is the most accessible of the regions, whether you're buying or selling. The family of my schoolmate Willy had a small dairy cow operation of about 150 cows that they moved from their small town in the mountainous Apurímac region to the coast, about an hour from Lima. He told me his father decided to move the operation to be closer to the Lima market, where they could get better prices for dairy products and buy and transport farm equipment more easily. The worldwide migration phenomenon is also taking place in Peru: populations are moving from rural areas to urban centers where resources and jobs are more easily accessed.

To say that the level of mechanization in some areas of Peru is low is neither surprising nor ground-breaking. Technologies such as tractors, pesticides, and pressurized irrigation systems are rarely seen except in commercial plantations on the coast. One common measure of mechanization calculated by the World Bank is the density of tractors throughout a country. Peru has a relatively low density, with a reported average of 36 tractors per 100 square kilometers arable land in Peru, whereas its neighbors, Brazil and Ecuador, have 131 and 123, respectively (World Bank , 2011).



Map 2.Peru: Human Development Index by Province, 2000. Stratification of provincial HDI: High, Medium High, Medium, Medium Low, Low.
Source:Informe sobre Desarrollo Humano, Perú 2002 (Report on Human Development, Peru 2002)

Peru, however, has improved greatly according to the United Nations' 2010 Human Development Report; it was ranked 63 of the 169 measured, making it a country with "high human development." Furthermore, it advanced 15 places in rank, according to the same report made a decade earlier (Andina, 2010). While the human development index does not directly measure mechanization, it does measure it indirectly as it accounts for education, life expectancy, and GNI per capita. A low income coupled with minimal access to education means that certain regions of Peru do not have the money or the knowledge to buy and operate machinery.

However, according to another report done by the Peru Office of the United Nations Development Programme, the interior provinces of Peru have a much lower human development index (HDI), suggesting a wide gap in the development between the coast and the interior of the country (United Nations, 2002). This is a common phenomenon in data collected for the country: HDI data from coastal Peru, which historically has been referred to as "official Peru", have more weight than those of the interior selva and sierra regions, called "deep Peru" (Kang, 2010). As Map 2 illustrates, the coastal provinces have much higher HDI; as you move towards the interior, the HDI typically decreases to 0.5 or lower. One exception to that can be seen in the small white dot amidst all the blue in the central southern region of Peru: that is Cusco, the city where I lived, which is the only province with "high human development" not located along the coast.

I mentioned earlier that the difference between a country like the United States and a country like Peru can be quantified, but that the quantifiable data can be hard to understand until you personally experience the difference. I often found this difference most clearly illustrated in my language use. Words that seem out-dated to me in English in Indiana have an everyday- applicability in Spanish in Peru. For example, the word *campesino* is translated into English as *peasant*; in either language the word suggests a rural class that is socioeconomically depressed. However, to me, a peasant is someone from the past; the word does not have a use in my everyday language in the

Photo 2. Using shovels and pickaxes to mix concrete for building a flood wall at an orphanage in Oropesa

United States because no one refers to the rural poor as peasants. In comparison, *campesino* is a word I used fairly often to refer to people in the rural areas surrounding Cusco. When I talked to my parents while I was in Peru, there were certain words that I had difficulty translating from Spanish to English, *campesino* being one that posed some consideration because until I went to Peru the word *peasant* did not have a modern use.

Another example is my use of the word *pico* and *pickaxe*, which refer to the same tool in Spanish and English, respectively. I associate the word *pickaxe* with mineral mining – images of the Seven Dwarves and Yukon Cornelius come to mind when I think of its use. However, the pickaxe has been used as an agricultural tool since prehistoric times; its use later evolved to include warfare, mining, and railroad construction. Today in the United States, the pickaxe does not have much of a

place as an agricultural tool. However, whereas today's average Indiana soybean and corn farmer might cite a combine or planter as his or her most useful tool, the average Peruvian farmer would very likely say a *pico*. I used *picos* for a wide variety of volunteer and school projects. To me it is the most incredibly diverse tool, used for tearing down walls, building roads, unearthing buried water hoses, constructing compost piles, plowing, and making irrigation canals. I used a *pico* for all of these things when I was in Peru. My greater use of the tool, coupled with the fact that the word has a different connotation or use for me in Spanish than it does in English, helps to demonstrate the generally lower level of mechanization in the sierra of Peru.

I noticed these differences from experiences I had not only in classrooms but also in trips I took to the rural areas of the region of Cusco and also Apurímac, the region that borders Cusco to the west. Further illustrating the level of mechanization in Peru is a day trip I took to Huironay, a remote town in the Apurímac Region known for its milk production. The average American commercial dairy farmer might have an operation of 2,000 or more cows, using a fully automated robotic system to milk the cows, then pasteurizing and homogenizing the milk on location. The town of Huironay operates a little differently. There I accompanied my schoolmate and good friend Gabriel Peña and his cousin Jaime, who worked across the Pachachaca River in the city of Abancay for his family's dairy plant. We set out in Jaime's milk truck before dawn, travelling five hours on a gravel road through mountainous territory that ended in a lush green valley. While Jaime attended to his business, checking pumping equipment and such, Gabriel and I set out to wander the town, passing women on the dirt roads on their way to the milk truck, carrying 20-liter buckets full of milk strapped to their backs by colorful blankets. Abancay, which has developed rapidly in the last two decades and is still growing quickly, has outgrown its supply of dairy products and now has to look to outside sources for milk. The city finds that source in tiny Huironay. The majority of the families in

Photo 3. Jaime's milk truck that we traveled in from Abancay to Huironay

Huironay have one or two cows that they milk by hand twice a day, and what they don't use for their families they sell to Jaime's dairy plant and others like it in the area. Once a week Jaime makes this ten-hour round trip to Huironay to gather the milk and talk business with the families. On this trip he held a meeting with all the producers; when Gabriel and I came back to the truck he and about twenty men and women were sitting on the ground passing around bread and Inca Kola, talking about the business.

This brings me to another point about mechanization and its effects, both positive and negative. The advantages of mechanization are obvious: higher productivity yields higher economic returns, which lead to a higher quality of life. While the drawbacks might not be as evident, they might be equally important. In the United States there is generally one individual or group of individuals that owns a dairy operation. The extensive use of automatic systems to milk cows results in a lower number of people employed by the operation. In contrast, there are about a dozen families

in Huironay that contribute to a single operation. This system lends itself to greater interdependency among the community members, and thus to a tighter-knit community. In his 2010 "Gender Roles and Rural-Urban Divide in the Peruvian Andes," Jung-Won Kang writes, "It is well noted that households in the Andes are strongly and extensively interconnected to each other for their livelihood." I imagine all the families of my parents' neighborhood contributing to one collective effort, and it makes me smile, because a suburb is designed perfectly to minimize neighborly interaction. Each house has just enough space between it and the next so that it is uncomfortable to speak to one another and so it gives you the option to not speak at all. Furthermore, you don't actually *need* your neighbor for anything, so there is never a necessity for interaction. This situation differs from that experienced by the individual families of Huironay, who need each other to collectively produce enough milk to make Jaime's business trip worthwhile. In Huironay, "households cooperate because they have to" (Kang, 2011). There, the functions of both a dairy operation and that of a neighborhood are joined to make one community.

Transportation

Along with mechanization, one of the key factors in successful commercial agriculture is a good infrastructure for transporting goods. I believe this is, and will continue to be, one of Peru's biggest obstacles to future development. In many cases there is no simple way to get a product to a market, particularly a world market. This obstacle is particularly difficult for Peru because of the extreme changes in geography over a relatively small land mass, from the chokingly dense rainforest to treacherous mountainous passes to the desert coast.

Transportation has long been a problem in Peru. Countries around the world, including the United States, have historically addressed their transportation limits with the use of waterways, treating rivers as highways. Unfortunately, the majority of rivers in Peru do not flow west to the

Pacific Ocean; rather, they join the Amazon, crossing the border into Brazil. This structure has limited Peru's possibilities in water transport. Starting in the fifteenth century, the Incas confronted the transportation problem and built an extensive road system throughout their entire kingdom, which spanned the Pacific coast and the Andes from Quito, Ecuador, to Santiago, Chile (Covey, 2006). However, after the Spanish conquest of the Incan Empire in 1532, the nation's efforts were refocused on mining gold, silver, rubber, and guano, which connected those products, rather than agricultural lands, to the coast (Lockhart, 1994).

Even after Peru's independence in 1821, there were no big government efforts to improve transportation between the three main regions of Peru. Today, only about a quarter of the Incan network has been rebuilt as modern highway (MacMillan, 1995). It was not until 1940 that it was possible, either by plane or highway, to reach all three main regions of Peru. As anthropologist Frances Toor described in her 1949 book *Three Worlds,* "From Lima, the capital, it was far easier to go to Europe, Africa, or Asia than to some of the parts of the Andes or the jungle."

Thus, one of the biggest barriers to the exportation of agricultural products in Peru is a lack of highways in the interior of the country. Or perhaps it would be more accurate to specify a lack of *paved* highways. Only 14% of roads in Peru are paved (World Bank, 2008). Other roads all over Peru are euphemistically named *carreteras*, or highways, which in reality are rutted and crumbling gravel or dirt roads vulnerable to mud and rock slides during the rainy season. I experienced roads like this in a lot of my travels, particularly if I was going anywhere that wasn't a main stop on a tourist route. Even then, roads frequented by tourists that are damaged by flooding or mud slides might be left unrepaired for months. One of the most popular tours to take while in Cusco, after Machu Picchu, of course, is a day trip to ruins in the towns of Pisac and Ollantaytambo in the Sacred Valley. In January and February 2010, some of the worst flooding the Sacred Valley has seen in

Photo 4. Seasonal rains can seriously inhibit transportation (Oropesa)

more than a century destroyed the bridge at Pisac, and mud slides severely damaged the road that switch-backed its way down through the mountains into the town. While the bridge was rebuilt inabout two months, in October, the highway to Pisac was still one lane in many parts, and the crumbling parts were lined by large rocks to prevent cars from driving over the side into the river. Accordingly, any travelling you want to do is seriously inhibited by the rainy season. Gabriel and I went to the city of Pucallpa after my semester ended in early November, which marks the beginning of the rainy season in the sierra. Pucallpa, a city of 250,000 located in the central rainforest, is almost due north of Cusco. However, because there are no direct routes to Pucallpa, you have to take a 20-hour bus ride all the way to Lima on the coast, then swing back inland, cross the same mountain range you came over to get to Lima just further north, and then dip down into the rainforest to reach Pucallpa. We were told that that the Lima-Pucallpa leg should last 10 hours, but on further

investigation we found out it was going to be closer to 20-24 hours because the road was washed out in some places, and it was common procedure for travelers to get off the bus, cross the washed-out area then get on another bus. When we got to Lima, we found out *that* wasn't even an option – the road was completely closed and no one was certain when it would be open again. At this point Gabriel and I opted to go by plane. What amazes me is that this city, which is *twice* the size of Muncie, Indiana, could be so isolated. Yes, it is possible to travel there by plane, but imagine for a moment the city of Muncie not being accessible by car for possibly four months out of the year. It's unthinkable in our American context of a completely drive-able country. But in Peru, it's just an obstacle of everyday life.

To put the transportation problem into an agricultural context, our purpose in travelling to Pucallpa was agronomically motivated. Gabriel was looking for seeds of two tree species, capirona and bolaina, to plant as a test run on his family's farm, located in the town of Quince Mil in the southern rainforest, five hours from Cusco. Capirona and bolaina are common in the Ucayali Region, where Pucallpa is located. They are both relatively fast-growing species whose timber is used for cheap house construction, wooden crates, and matches. There is a demand for both of these species in Tacna, which is a trading city in southern Peru on the border of Chile. However, they are hardly ever grown commercially in the southern rainforest, although the climate and soil types are similar to those of the Ucayali Region. It is incredible that two such useful timber species have rarely been planted in the southern rainforest. More incredible is that in order to buy the seeds and find proper information about the cultivation of both species, it was necessary for Gabriel and me to travel such a long distance. We spent a lot of time in Pucallpa travelling between the public university there and the National Institute of Agrarian Innovation (INIA), the agronomical research institution, reading theses and talking to representatives and agronomists. This technique of research – travelling to some place other than a library to find information that required talking with other human beings – seemed

human beings – seemed so old-fashioned and informal to me after semesters spent researching peer-reviewed journals in online databases. But I must say it also felt more rewarding when we found what we were looking for.

While many parts of Peru remain unconnected, it should be noted that the government has done a commendable job in the last few decades of trying to improve the country's infrastructure. In the 1980s, the construction of the Pan-American Highway connected Lima and Cusco by paved road for the first time. Before that, the trip from Abancay to Cusco, which is now a four-hour trip by bus, took an entire day. Similarly, the trip to Gabriel's family's farm in Quince Mil is much shorter travelling on the new Peru-Brazil international highway that is still under construction. The section from Cusco to Quince Mil was just completed in 2009, cutting travel time from twelve hours to a mere five.

Photo 5. The construction of a Peru-Brazil highway has significantly improved transportation between Cusco and small towns such as Quince Mil

Gender roles & globalization

Technology and infrastructure represent two huge factors that contribute to the current state of Peru's agriculture. A less obvious but equally important factor that I believe will also play a role in the future of Peru's agriculture is gender roles. While gender roles in Peru's agricultural communities can be very rigid, depending on the region, division of labor is fairly heterogeneous throughout the country.

Women of the *campesino*, or peasant, class in the sierra have historically participated in a wide range of agricultural tasks, more so than peasant women in the selva and on the coast. In those locations, women participate primarily in the harvesting of crops, and less in land preparation, irrigation, and planting. On the coast, women help to harvest crops in larger commercial plantations that require fine motor skills, such as cotton and grapes. In the sierra and the selva, women are more likely to work on small family plots, where they perform a wider variety of agricultural tasks, including sowing, weeding, and harvesting. Women in the sierra are more likely to participate in labor such as land preparation and irrigation than in the other two regions, but their responsibilities have a wider focus than those of men (Food and Agricultural Organization, 2005). Women's responsibilities are first focused on household food production and childcare, but then are widened to include a variety of agricultural tasks.

As seen in Table 1, reprinted from Jung-Won Kang's 2010 study, "Gender Roles and Rural-Urban Divide in the Peruvian Andes," women's tasks are typically more varied than men's. The division of agricultural labor by gender is described for Carhuayoc and Huaripampa, two agricultural communities located in the north central Peruvian Andes. It is well noted that several of the tasks for men and women overlap. In their article, Deere and León de Leal further observe that division of labor by sex "is not just culturally determined, but is itself responsive to material conditions of

	Men's Task	Women's Task
Agricultural activities	• plow • plant • thresh • lift heavy loads • apply fertilizer and pesticide • fix tools • repair infrastructural facilities	• plant • process grains • prepare products for storage • prepare meals for field workers • sort potatoes • sell crops at a market
Animal husbandry	• kill animals • butcher • buy and sell livestock	• fetch grass and water • graze and herd animals • clean animal • collect eggs • shear sheep • buy and sell livestock • sell animal products at market

Table 1. Technical division of labor by gender in two Andean communities in Peru, Carhuayoc and Huaripampa (Source: Kang's "Gender Roles and Urban-Rural Divide in the Peruvian Andes," 2010)

productions" (1985). Agricultural gender roles are fluid enough that if there is no man available to complete a task, a woman may take over, but if a man were to become available, then the woman would no longer be responsible for the task (Deere & Léon de Leal, Women in Andean agriculture: Peaseant production and rural wage employment in Colombia and Peru, 1985).

This means that women can be the head of a household, but generally as a result of the death, migration, or abandonment of the husband (Kang, 2010). Another way a woman might become the effective decision-maker of the household, even when the husband is still present, is if the husband were to become incapable of fulfilling his duties, usually due to injury or alcoholism. This was a circumstance I saw as a volunteer during my first semester in the agricultural community of Anta, nestled in a valley about a half an hour outside of Cusco. The town suffered some flood damage and had asked the volunteer organization to help rebuild some of the roads that were most affected. The only town members we saw throughout the day were women and children. When someone in my group asked where the men were, a woman responded that they were at home, asleep. Later, our development professor explained that Anta has a problem with alcoholism, and that most of the men

Photos 6-7. The sole participation of women in communities such as Anta can be explained by the alcoholism that afflicts many of the men in the community

were *borrachos*, drunks. By default, the women were the principal bread-winners and decision-makers of their households.

While I did not participate in peasant agriculture directly, my classmates and I in our soils class grew a variety of crops such as potatoes, fava beans, corn, lettuce, and alfalfa. I would argue that this class, which was comprised of students who often came from farming backgrounds, was a microcosm representative of the larger agricultural picture in Peru.

Discussing my personal experience with gender roles in Peru is a bit complicated, because, while I am a woman, I am also Caucasian. Therefore, any differential treatment I may have experienced could be attributed to my gender, my ethnicity, or a combination of the two. However, I still feel the ideas of Deere and León de Leal were reflected in the agricultural work I participated in and observed in my second semester at the Granja K'ayra, UNSAAC's agronomy and zoology campus. In my classes, it was acceptable that men and women co-performed tasks. However, if there were a sufficient number of men and women, then tasks were divided by sex, with men performing more difficult labor and women performing any tasks that were left over.

Examples of this abounded in my soils class, which generally adhered to gender roles more rigidly than many farming families would. Presumably because of the amount of labor available, there were a sufficient number of men to complete characteristically "male" tasks, and so the women in the class were assigned strictly "female" tasks such as weeding. I also would argue that my professor, who was probably in his sixties, was subject to a strong sense of *machismo*, the belief that masculinity is superior to femininity. Upon arrival to class, the men would be assigned a variety of tasks such as digging canals, harvesting alfalfa, moving compost, and constructing raised beds. The women in our class, who numbered eight of the total thirty students, would gather together, then stand around for about a half an hour waiting for the professor to finish assigning jobs to the men. Eventually one of the women would say "*Ingeniero*, what do you want us to do?" He would look at

Photo 8. Students' plots of potatoes, fava beans, and corn in my soils class

us as if he had forgotten us, then tell us to weed the lettuce plots or reorganize the oregano plants, which we did a total of five times during the semester.

Another typically female task mentioned in Table 1 is "prepar[ing] meals for field workers." My class was sometimes required to work on Saturdays, and often, rather than do any work related to food production, the women were responsible for providing food for our male classmates. In one memorable conversation, I asked my friend Edu, who was building a compost pile, what I could do to help. He laughed, and replied, "Make me lunch." On these days we women gathered money from our classmates and bought soda, bread, avocados, and bananas from a store that was across the street from the university entrance.

Another Saturday we collected money and bought potatoes and cheese from an on-campus facility in order to prepare *huatia*, which is the process of cooking potatoes in an above-ground oven

Photo 9. Huatia

constructed with clumps of soil. After the oven is built, dry grass or plant matter is burned until the oven reaches a sufficiently hot temperature, at which point potatoes are placed inside. The oven is then collapsed, the hot soil cooking the potatoes underneath. Among my classmates, this process was also divided into gender-specific tasks. First, the women collected the potatoes. The men then constructed the oven, put in the potatoes, collapsed the oven, and then removed the potatoes from the hot soil under the instruction of the women. The women then distributed the potatoes, cheese, and *ají* pepper sauce among the classmates. I've been told since that *huatia* is a process that can be done by a

man or a woman, (unlike another cooking method called *pachamanca,* which cooks food underground, and is always constructed by men), but in my soils class that day there was a definite line between the female and male tasks.

While my experience at UNSAAC demonstrated a fairly rigid division of labor, I also noted that, outside of my *macho* professor in soils (who didn't proactively discriminate against the women; rather, he just ignored us), female classmates were not subordinate members of the class. They just had a different role to fulfill. The same was true of the *campesino* woman, whose role, while valued, is typically separated from that of the man's. These roles are affected by a number of factors that are in the midst of change. These include the previously-discussed development of mechanization and transportation in rural areas, two issues that are intimately related to globalization. For me, the effect of globalization in Peru was easily seen in the Red Bull sold at all of the Mega *supermercados* in Cusco, or in the fact that the 19-year-old son of my host family constantly is posting Lady Gaga's music videos on his Facebook page. However, I also saw the effect of globalization in my host mother's job with a Mary Kay-style catalogue, which celebrated strong but feminine beauty. These examples I saw in Cusco, which is an urban center. However, I've also watched Michael Jackson music videos on flat screen televisions lining muddy aisles in an outdoor market in Haquira, a town that is located an 8-hour drive from Cusco via gravel and dirt roads. My point here is that although consumer goods are the first point of contact in the process of globalization, they are followed by ideas, historically Western ideas that, among other things, empower women. It will be interesting how these ideas will or will not infiltrate Peruvian society, particularly in remote agricultural communities that historically have not had much contact with their neighboring provinces, let alone with other countries.

Another facet of globalization is the rural-to-urban migration phenomenon that was earlier discussed in relation to mechanization. This phenomenon, which typically is first manifested through

the migration of male household members to urban centers in search of jobs, leaves women at home to look over the *chakra*, or farm. In the last few decades, an increase in female-headed households has been noted. This shift significantly changes the role of the woman in both the household and the community, leading to higher economic independence and a bigger role in decision-making (Kang, 2010).

Education

Another important factor for the future of any economic sector of a nation, agriculture included, is the education of its youth. Like agriculture, education varies dramatically from region to region in Peru, with more sophisticated technology used in the schools on the coast and increasingly less technology used as you move to more remote areas of the sierra and the selva. Here I will focus on the university, specifically the national public university, as it is the institution with which I am the most familiar.

National universities are free, but in order to be admitted a student must pay to take an exam that is offered twice a year. This exam tests the student's knowledge of science, math, history, and reading comprehension. The score places the student in his appropriate college. At the San Antonio Abad National University of Cusco (UNSAAC, for short), the highest scoring students study medicine, which is by far the most prestigious field at the university and in Peru in general. Each college has a minimum score that officials will accept. This means that if a student gets too low of a score to get into his chosen career, he will need to either pay to take the test again, study something else or not attend the university. However, as the development professor my first semester explained to the class, it is hard for young people between the ages of 18 and 24 to get a job and so most choose to study a "lower" career. The College of Agronomy and Zoology has one of the lowest requirements for students, at a minimum of 13 (on a scale of 20). Thus many students studying agronomy are not

necessarily motivated to become agronomists. This seemed to be the case at UNSAAC. I asked my friend Jose about this, and he told me that he thought maybe one in ten students studying agronomy at UNSAAC actually wanted to do anything with it after graduating. He himself wanted to study medicine but received too low of a grade on his entrance exam. When I went to Peru, I initially thought that it was a good idea that the national universities offered free education to its students. Now I believe that higher education at no cost can be more of a moral hazard than a motivation. In this system students will attend a university even though they may not be at all driven in their field. Most of my friends in the United States who have dropped out of college cited indecision or bad grades as their reason for quitting. They did not want to be paying so much money a year if they were not sure what they wanted out of it or if they were not succeeding. There is no consequence for a Peruvian student's indecision or bad performance in a national university, however, he or she can still return semester after semester. As a result, in addition to the fact that agronomy traditionally admits lower-scoring students, the future of agriculture in Peru is uncertain, particularly in regions such as the sierra and the selva, where the expectations are lower. Of course, there is some advancement in this field. For example, the Molina University in Lima is well known as an agronomical research institution. However, the system often seems to set itself up for failure and that worries me a little for its future and how it will affect agriculture.

Agriculture in Peru is a multi-faceted issue, and its future will be decided by the ways that these factors interact with one another. Its future will be affected by not only physical and technological issues such as transportation and mechanization, but also broader ideas that are incorporated into education and women's rights. Yet another factor that will contribute to the future of agriculture is Peru's management of its natural resources. This management of food crops, industrial crops, and the non-biologic resources that support their survival, will be an integral factor in deciding the future of agriculture.

In this section I will discuss three of Peru's natural resources: water, coca, and the potato. I chose these three not necessarily because they are Peru's most important. Indeed, many could argue that the mineral wealth that brought Spanish conquistadores and the fall of indigenous rule in Peru is more important. Or it might be argued that fish, which helped Peru to boast the second largest coastal fishing market in the world after Japan, or Targüis cotton, a Peruvian variety of cotton that is the some of the finest and most pest-resistant cotton in the world, is more important. I chose these three, however, because they all hold some personal importance to me regarding the time I spent in Peru. In the following pages I will explore the history behind each of these three resources as well as their prospective futures. Furthermore, I will explore how globalization and international pressure can define a market, as is the case with coca and with the potato, or a health crisis, in the case of water.

Water

Water is a resource that I have certainly taken for granted in my lifetime, although many of my studies have been focused on its science and allocation. Water is one of Peru's most controversial natural resources and with good reason: virtually all of Peru's water resources are on the opposite side of the country's main population. According to the World Health Organization, the coast holds 57% of Peru's population, but only 2% of its available water. And as discussed earlier, almost all of Peru's commercial farming is on the coast. As President Alan Garcia put it, "Most of our water supply is on the wrong side of the wall" (Painter, 2007). The demand for water for domestic, industrial, and agricultural uses must be met by transporting water from the Andes or the Amazon.

In Peru I had to think actively about my water for the first time in my life. I've studied water resources of the United States and other countries, tested water quality at a local reservoir, and discussed water laws with classmates. I feel fairly knowledgeable about its chemistry and roles in

biology. But my experience in Peru was the first time I had to confront water issues not just in the classroom but in my home as well. I had to think about boiling tap water to make it safe to drink and the times of day I would have water, or whether I would have it all. This is not to say that my access to water was limited, but it was my first personal experience with turning a faucet and not being entirely sure what would happen.

To talk about water in an agricultural context, one must discuss irrigation. The story of irrigation in Peru is very similar to that of the country's road system. Early Peruvian societies developed irrigation systems, some that crossed long distances and demonstrated sophisticated engineering, but when the Spanish toppled the Incan empire in 1532, they shifted the country's focus away from farming and toward the mining of tin, silver, and gold and the harvesting of rubber and guano (Lockhart, Spanish Peru: A Social History, 1994).

Pre-Incan societies such as the Nazca and the Moche constructed aqueducts to irrigate their crops in desert environments. The Incas, whose empire spanned the fifteenth and sixteenth centuries, depended heavily on agriculture and constructed sophisticated irrigation systems to supply water to their vast terraced fields in the sierra and to over 700,000 hectares of diverse crops on the coast (MacMillan, Andean Farming for Present and Future, 1995). Today many of the canals still function; water runs from natural springs by gravity to the ancient fields of the Incas, which are now tourist destinations.

Given that you can't spit in Cusco without hitting something Incan, it's pretty easy to take these ruins, and the sophisticated engineering required for their construction, for granted. I reluctantly admit I started saying "those piles of rocks" after about three months of endless tours and guides explaining the physics of Incan architecture, but neither that phrase, nor the word *ruins*, seems appropriate to describe engineering that still works after 400 years of neglect. The Incas often employed a type of masonry called polygonal masonry, which did not rely on the mortar to bind the

stones of the walls and canals. Rather, they used the unique shape of the stones to fit them together intricately so that they would not only stand the test of time, but also that of earthquakes that frequent the sierra. Often the irrigation systems were engineered to divide equally the discharge of a spring, so that all fields were irrigated with the same flow. In Tipón, agricultural ruins about 20 minutes outside of Cusco, there are examples of still-functioning fountains that split the flow from springs into four canals, all with exactly the same flow.

The Incas realized great achievements in their vast network of irrigation canals, both in its sheer span and its detailed engineering. However, when the Spaniards conquered the Incan empire in the 1500s, as mentioned earlier, they shifted the country's focus to mining, causing a decrease in agricultural production all over the country. On the coast, agricultural land use was reduced from

Photo 10. Incan engineering at Tipón

700,000 hectares to 300,000 (MacMillan, Andean Farming for Present and Future, 1995). In the early twentieth century, as well as in the 1980s to '90s, political and social unrest prevented agricultural development, and irrigation was not a priority. This situation has changed in the last few decades, and the national government has invested about five billion dollars in hydraulic infrastructure, including irrigation and drainage systems (Painter, 2007). One of the biggest hydraulic projects the government has undertaken is the Limon Dam, which carries water over the Andes from the Huancabamba River to the coast in northern Peru.

Most of these projects have been in coastal regions, but one that has caused a big stir in the Cusco region is the Majes-Siguas II project. It is a continuation of the first Majes-Siguas project that was started in 1985, under Alan Garcia's first administration, and it proposes to divert water from the Apurimac River from the department of Cusco to irrigate fields in the Arequipa region. The project is touted to eventually generate over 500 million dollars for southern Peru. However, there is disagreement over whether the river, especially in the dry season, can support both Arequipa's irrigation needs and Cusco's drinking water needs. Although the project would affect the southern part of the Cusco region, and not the city of Cusco directly, I saw several protests in response to the Majes-Siguas II Project. In September, a particularly forceful protest on the southern side of the city shut down the airport, delaying flights by a day and leaving about 500 tourists stranded. "The decision to suspend flights was made when about 1000 protestors broke through the airport's walled perimeter," I read later in the online newspaper *Peruvian Times*. "The police, who numbered approximately 40, were unable to prevent the demonstrators."

This protest brings another point to the forefront: water in Peru, as in the United States and the world over, has become a very political, and politicized, issue. The week I left Cusco, I saw the cover of a periodical called *Lucha Indígena,* or *Indigenous Struggle,* that read in capital letters, "Water isn't a business, it's a human right," and had a photo of protestors marching at the SEDAPAL

building in Lima. (SEDAPAL stands for Servicio de Agua Potable y Alcantarillado or, in English, the Potable Water and Sewer Service.). The government has recently moved toward the decentralization and privatization of SEDAPAL, which I feel would help improve access to potable water and the quality of wastewater treatment. However, many Peruvians, particularly the poorer *campesinos* in rural areas, feel that privatizing SEDAPAL will drive up prices.

As further evidence that water is a political issue, water laws and projects are very susceptible to the ebb and flow of presidential terms. Work on any project, hydraulic or otherwise, is at risk every five years when a new presidential administration is brought into power. If the new president does not support the previous president's project, or more likely just wants to forge a new venture under his name, a half-finished project will be abandoned in favor of another. This is why the Majes-Siguas II project is called "the second," because the first one was abandoned in 1990, when Alberto Fujimori became president, and then resumed under Garcia's second term. Furthermore, as seen with the SEPAPAL and Majes-Siguas protests, when Peruvians feel strongly, or even mildly, about a political issue, they strike about it. During my ten months in Peru, probably a month's worth of strike days occurred. These varied in intensity, from just a few marches in the Plaza de Armas or a group of people picketing at the Palacio de Justicio, to a complete shutdown of main streets, with protestors discouraging drivers by blocking the roads with rocks and broken bottles. What is particularly ironic about strikes is that often no one seems to know why there is a strike. I would ask classmates the reason for the strike and they'd shrug and say, "Gas?" When I'd ask if that meant natural gas (which is plentiful in the Amazon) or gasoline, I'd get another shrug and a reply such as, "I don't know. Both?" It seems that strikes are used more as a day off than as a political platform. When I asked Gabriel why there so many strikes, he replied, "I don't know, we've had them for as long as I can remember."

Photo 11. The cover of *Lucha Indígena*, which reads, "Water isn't a business, it's a human right"

Peruvians are vulnerable not only to the caprice of their current administration, but also to that of foreign administrations, according to American journalist Michael Fumento. In 1996, he published an article titled "Dirty Water" in *Reason* magazine that blamed Peru's 1991 cholera epidemic on American imperialism. Some had claimed that chlorine was a hypothetical cancer risk made by Greenpeace and the EPA in the late 1980s; as a result, argues Fumento, Peruvian officials reduced their chlorine use as a disinfectant in drinking water facilities (Fumento, 1996). This left the coast's water supplies vulnerable to cholera-contaminated bilge from a Chinese freighter that disposed of its waste off the coast of the fishing town Chimbote. The contaminated water seeped into open wells, which hadn't been chlorinated, and then to fresh water supplies where levels of chlorination had been so decreased that they didn't do anything (Franco, 1997). That year Peru had over 300,000 cases of cholera and more than 600 deaths. Not only did it affect Peru, but this cholera outbreak served as the point of origin for cholera epidemics that spread through all of South America (Arbona & Crum, 1996). This tragedy exemplifies the negative effect that globalization can have, particularly the influence a developed country like the United States can have on a less developed one, even if it "doesn't come at the point of a bayonet" (Fumento, 1996).

More than just poor international communication, there is a lack of communication between the regions. As my political science professor put it, "Lima is the father, and all the other cities are his children and have to do as he says." So, for example, whereas most water rights and allocation decisions are made state by state in the United States, in Peru they're decided nationally. The decisions that are made in Lima are made for all of the regions. And while it would be arguably illogical to make environment-dependent decisions such as agricultural or water laws in Washington, D.C., for all the diverse parts of the United States, this practice is even more unreasonable for Peru, whose diverse ecology includes 80 of the 83 ecosystem types. It's virtually impossible to find a

nation-wide law that fits the requirements of every land type in Peru, from the coast to the sierra to the selva, and every subtle nuance in between, of which there are plenty.

Eighty percent of all water withdrawal in Peru is used for irrigation, and sixty-eight percent of that is used in the arid coastal regions. When you take the bus from Cusco to Lima, a 20-hour trip that goes from 11,000 feet to seal level, you wake up in the morning in the desert foothills of the Andes, the dip down into a dusty and barren landscape spotted by only a few tiny towns painted with political candidates' propaganda. I took this bus ride four times, and every time I was impressed by just *how infertile* the land looks (although the soil is actually rich in nutrients, the climate is extremely dry). I've driven through the southwestern United States, but those vistas did not make the impression that this drive did. Where there are sparse desert shrubs and scraggly cacti in the southwestern US, on this part of the Pan-American Highway there is nothing – nothing but the signs lining the road that read *Propiedad Privada*, Private Property, as a warning against trespassers and squatters. Those signs always seemed sadly funny to me, because someone who would want to trespass on such inhospitable land must be in a desperate situation indeed, and whoever feels the need to protect it is perhaps in an even worse one. In this bone-dry region, agriculture is virtually impossible without extensive irrigation systems.

As you get closer to Lima, lush fields of green start to pop out of the sandy landscape, seemingly out of nowhere. Their appearance is due to the extensive use of irrigation on the coast; without it this scene would be barren. While the coast on average receives fewer than 40 millimeters of rain each year, over two-thirds of the agricultural GDP is produced in the coastal regions. Often, due to ill-managed and deteriorating irrigation systems, over half of the 80% of withdrawn water is lost. These inefficient irrigation systems lead to higher salinity of the water, which can affect urban water supplies. Also, sewage often gets into irrigation systems, contaminating the irrigation water used to grow crops (Arbona & Crum, 1996).

Photo 12. Nazca, in the coastal department of Ica. The arid coast depends heavily on irrigation for its agriculture

In Cusco, to say that sewage "often" gets into irrigation systems would be a gross understatement. One of the first things I was told upon arriving in Cusco was to not flush toilet paper down the toilet, but rather to put it in the trash can that is next to every toilet in Peru. It was explained to me that the system couldn't handle that much matter, but I found later that it had less to do with the *quality* of the sewage system and more to do with presence of *any* sewage system. Despite being one of the country's wealthier cities and its biggest tourist destination, due to its proximity to Machu Picchu, Cusco does not have a wastewater treatment plant. San Jeronimo, the most rural of Cusco's districts, which was incorporated in the municipality of Cusco only in the late 1980s, has a small wastewater treatment plant. However, even if there were a way to pipe all the wastewater to this facility, it is completely unequipped to handle all of the sewage coming out of the city. Somehow, amazingly, I failed to find out this fact until my last month in Cusco. It was never

mentioned in the classes I took over the course of the year in soil sciences, irrigation, and rural development. I found out only when I asked a schoolmate offhandedly where the wastewater treatment for the city was located.

With no treatment system in place, all of the wastewater just goes straight to the Huatanay, the small river that travels through Cusco Valley. The Huatanay crosses through the Granja K'ayra, the agronomy and zoology campus downstream of Cusco where I studied agronomy my second semester. Students affectionately called the bridge on campus that crosses the river the *Puente de Buenos Aires*, the Good Air Bridge, or *Puente de Suspiros*, Bridge of Sighs, because of the sigh you let out after holding your breath while crossing it. Not only is the river contaminated with the raw sewage flowing out of Cusco, but there is a pipe coming out of a warehouse on campus that drains the blood from butchering cattle. On days when cattle are butchered, the river literally runs red, and stray dogs and carnivorous birds wade through the water looking for pieces of meat. On more than one occasion, I saw dogs come out of the river carrying bloody bones.

Between the raw sewage and untreated blood going into the river, an accurate picture is painted of the quality of water being used for irrigational purposes downstream from Cusco. And I can only imagine that, rather than being the exception to the rule, this example is fairly representative of other water systems in the sierra. Even in the more developed coastal regions, the disposal of raw sewage directly into the ocean is commonplace.

Access to water, while it has improved immensely in recent decades, is still unreliable in some parts. There are certain parts of Cusco that, while fully equipped with piping, have the water turned off for the majority of the day. During my first five months I lived with a host family in a neighborhood by the airport, where the water turned off every night somewhere between 6 and 9 p.m. At night, if I flushed the toilet, I had to refill the bowl with water from a trashcan my family kept full in the kitchen. During the floods of January and February, sometimes the water was turned off

Photos 13. The view of the Huatanay River from the bridge that passes through the Granja K'ayra, UNSAAC's agronomy and zoology campus

several days at a time, and, unsurprisingly, strikes sprang up around the city in protest. Even if water was available all day long, often water pressure was not maintained for twenty-four hours a day, and so wastewater could flow into pipes that are cracked (Arbona & Crum, 1996).

Coca

Water is surpassed as Peru's most controversial resource perhaps only by the coca plant, whose leaf is used to produce cocaine. "It is an unassuming bush, with green elongated leaves and slender branches.... In the sub-tropical valleys of the eastern Andes, where it flourishes, other plants, like orchids and banana trees, are more lush and eye-catching." This passage, written by Orin Starr in his introduction to a collection of essays called "The Cocaine Economy," is reminiscent of the first time I saw a coca plant. I had tagged along with Gabriel to his family farm in Quince Mil, a town "in the

door of the selva," in a region somewhere between mountains and rainforest called the cloud rainforest. We were visiting the farm of his neighbor Mario when I asked, "Which is the coca?" "The little green one," Mario replied, gesturing broadly at a landscape that was entirely green.

For such an inconspicuous plant, coca has stirred up more trouble for Peru than any other export. And although Peru is no longer the world's biggest exporter of coca, having been passed by Colombia fifteen years ago, the plant still helps to shape the relationship that Peru has with the rest of the world, especially with the United States.

Photo 14. Harvesting coca on Mario's farm in Quince Mil

Photo 15. *Mate de coca* is used a remedy for altitude sickness, fatigue, and stomach aches

The US has been implementing drug control programs in Peru for decades, all of which have been based on the idea that coca production is a recent occurrence. Many Americans would have you believe that coca production started in the 1970s, when the demand for cocaine production exploded in North America, but the reality is that traces of coca have been found in Peru dating more than 3000 years ago. It has been used in Andean culture for centuries to help stave off hunger and give energy to workers in fields. It's also used as a remedy for a general smattering of intestinal problems. I didn't have any personal experience with coca in its more volatile form but I did have plenty of run-ins with the coca leaf, all of which were positive. According to Peruvians, it's a basic cure-all. Altitude sickness? Headache? Stomach pain? Fatigue? "Drink some *mate de coca*" is almost always the remedy suggested for any of these ailments, all of which I suffered from at least a

little. I experienced horrendous food poisoning my second month in Peru, the more indelicate details of which I will leave out, and my host mother forced me to drink *mate de coca* even when I refused everything else. And it helped.

It is important to understand, as Bolivian president Evo Morales said, that "la coca no es cocaina." Coca is not cocaine. Cocaine is one of the eleven alkaloids found in coca; it is refined to make purified forms of cocaine, the fine white powder that people the world over associate with the notorious drug. However, most countries, including the United States, do not distinguish between the coca leaf and refined cocaine, especially since, in 1952 the World Health Organization Expert Committee on Drug Dependence concluded that "coca chewing must be considered a form of cocainism" (Argandoña, 2006). And while it is true that many poor farmers in the Andes turn to coca production to sell to international drug buyers, coca is an integral part of indigenous Peruvian culture.

Coca is used as a social tool, particularly in the more remote parts of the Andes. Community members take part in chewing ceremonies called *phukuy*. In the ceremony participants take three coca leaves between their fingers, blow on them, and essentially make a wish, sending a message or prayer to the *apus*, the spirits that are the mountains. Social hierarchies and community relations are communicated in these rituals, depending on who performs the *phukuy* first and where people sit during the ritual. It also supports more informal communication between neighbors and communities. When you greet a passing friend on the road, it is common to take a minute to chew coca together and chat. In this way, coca has become a very important cultural aspect of many Andean communities (Allen, 1995).

The coca plant has come under much international criticism in the last century, however, putting the long-held cultural practice of its consumption at risk. In 1986 Ronald Reagan declared his "war on drugs," citing drugs, particularly cocaine, as a national security threat. Three years later, in 1989, George Bush sent US military as part of the Andean Strategy to stop cocaine production "at

the source" – the Huallaga Valley where over half of the world's coca crop was grown at the time. The Huallaga Valley soon became a war zone as the US military, national guerrilla factions, international drug lords, and Peruvian coca farmers fought over this "Andean treasure and international villain housed in the same green sheath" (Kawell, 1995).

Interestingly, Peru's booms and busts in the coca market have long been intimately tied to the United States' interchanging of support and regulation. The first international demand for coca came in the 1880s, two decades after German chemist Albert Neimann first isolated the cocaine alkaloid from the coca leaf. Chemists and pharmaceutical companies in the United States and Europe that were interested in the medical benefits of cocaine created this demand. Peruvian officials were thrilled that coca had an international market for the first time and pushed its production in the Huallaga Valley. Over a half-century later, in 1942, the US government helped to finance the construction of an experimental agricultural station on the Montaña Road (also funded in part by the US government) leading into Tingo María, the principal city in the Huallaga Valley. This station's purpose was to obtain products such as rubber, quinine, and insecticides for World War II, and to research innovative agriculture in the valley, particularly in the cultivation of coffee, tea, cacao, and coca.

The Huallaga Valley is located in the high-altitude rainforest in north-central Peru and is characterized by fertile soils and a good climate for those crops, making it an ideal spot for commercial agriculture (Kawell, 1995). However, this vision went by the wayside in the 1970s when the rising popularity of cocaine as a recreational drug in the United States and Europe motivated an increase in coca production in the Huallaga River Valley. The United States government supported drug control programs in the Huallaga, starting with the 1979 Operación Mar Verde – the Green Sea Operation – in which the Peruvian military was sent to stop coca production. Many farmers, who were licensed to grow and sell coca to the state-run National Coca Company (ENACO), were

arrested and saw their fields and livelihoods, which they saw as completely legal, destroyed. A decade later the American military was sent to the valley to carry out its coca-eradication plan as part of the Andean Strategy. Thus the punishment has come from the same place as the demand.

The damage caused by these operations to the Peruvian image of the US military left a space for authority that was quickly filled by the group the US most opposed. The Shining Path, a guerrilla organization that terrorized Peru for most of the 1980s, took hold of power in the Huallaga Valley. Shining Path soldiers toted signs that proclaimed things like, "Down with the imperialist coca eradication plan!" (Kawell, 1995). It's pretty hard to blame Peruvian coca farmers for taking shelter with the guerrilla faction when the US and Peruvian governments, two countries that have famously upheld the small farmer, were both trying to destroy their economic livelihood. The conflict came to a head when the Peruvian government outlawed the cultivation of coca; this law included a clause making protest of the law also illegal. The US Agency for International Development drew up plans for a $176 million, five-year development project whose aim was to provide farmers with alternatives to coca, but it was never fully implemented.

In the end, despite the millions of dollars the US government has devoted to stopping coca cultivation, it remains a staple in Peruvian life. And now the Andean countries where coca is an integral part of culture are stepping up to defend it. Peruvian officials who had initially supported coca eradication started to disagree with US initiatives; in his first administration, Alan García began to promote the idea that in order to effectively combat the Shining Path, his most important objective, the Peruvian government needed the coca farmers on its side. Thus coca cultivation was made legal again, which caused an international uproar. García was criticized extensively by the United States, fueling suspicions that the Peruvian president had been bribed by drug mafia members (Kawell, 1995). Administrations that in the past carried out US-supported coca eradication programs are now speaking out in support of coca and the indigenous culture of which it is a part. Evo Morales,

Bolivia's first president of indigenous background, has been a big defender of coca. The aforementioned Alan Garcia also publicly supported coca and encouraged its use in tea and salads (Argandoña, 2006).

Historically, the clashes between American and Peruvian have come at the point where American constituents come to carry out an American initiative; they have knowledge or an idea they want to impart to Peruvians. They come as an authority where they aren't one. I mentioned earlier that there is a way of doing thing in Peru, just as in every country. If you try to do anything in Peru with an American attitude, as shown in my very small example of trying to sign up for classes at the university, you may not fail, but you will expend a lot more energy than a Peruvian would to achieve the same aim. I did not do anything groundbreaking during my time in Peru, but I do know that I possessed one quality that a lot of Peruvians don't expect from foreigners, and that is receptiveness. The majority of Americans and European who come to Peru (in general, white people), who are not in Cusco just for the one-night stay en route to Machu Picchu, come as authority figures. That is, they have roles such as project managers or missionaries. They include the Italian student who helped to design and implement the new biodigester at K'ayra, and the Americans who ran the restaurant and Christian meeting place in the plaza by my house. This is the same role that the US military fills in the Huallaga. These are people who have come with some kind of knowledge or skill they want to impart. Even in my first semester as a volunteer there was a sense of "I have something that you don't that I can give you," and that was the technical skill of building a stove. In my second semester, I came with neither knowledge nor skill; I came only as a student, and a disadvantaged one at that. I hadn't mastered the language and, more importantly, I did not understand the system. I realize that US officials would not be in Peru at all if they were not there to accomplish a pre-determined aim. But if they were to adopt more of a receptive attitude, they would find Peruvians to be more receptive as well. Rather than expend all their energy destroying the coca market in Peru,

American officials would do well to help build up another market, say, that of the potato, to achieve the same end.

Potato

Water and coca may be what brings Peru the most controversy in its national and international relations, but the potato is the resource that forms the backbone of the Peruvian diet. Almost every meal I ate in Peru was served with potatoes, whether boiled, fried, stuffed, or freeze-dried. When you eat at a *pollería* – the Peruvian equivalent to an American burger joint but with chicken instead of beef – generally more than half of your plate is *papas fritas*, or French fries, because potatoes are cheap and readily available. This tuber represents 15% of the food availability in Peru, with 95% of it being cultivated in the sierra (Quispe Velásquez). In fact, I cultivated some potatoes of my own, in my soils class. For these reasons – the sheer quantity of potatoes I ate in Peru plus the opportunity I had to grow a crop in its birthplace – the potato is the final resource I want to discuss.

It makes sense that the potato would have such high consumption in Peru, the cradle of its domestication. All species of potatoes are thought to come from one species in southern Peru. The International Potato Center, which is the largest potato germplasm bank in the world, is located in Lima. Certain varieties of potato have long been cultivated in *la puna*, the high sierra above 12,000 feet where other crops might not survive the frosts. Potatoes were a staple in the diet of the Incas, a society well known for its sophisticated agriculture adapted to diverse geography and a multitude of microclimates. *Chuño*, which are potatoes freeze-dried underground at altitudes above 10,000 feet, can be stored for several years without losing their nutritional value. In all these ways the potato has earned its place at the top of the list of Peru's most vital resources, as well as providing an agricultural perspective that is unique to the country (Chapman, 2000).

In a sustainable agriculture course I took at Ball State, I was taught that Ireland's potato famine was caused by the Irish peasants planting too many potatoes; they should have planted not only potato, but wheat, oats, and barley as well. However, according to a course I took at the university in Cusco on the biodiversity of Andean crops, the peasants' mistake was quite the opposite – that they didn't plant *enough* potatoes. Rather than plant only the one variety of potato, they should have planted dozens, as Peruvians have been doing for centuries. The potato is an incredibly diverse crop. The nine species of potato cultivated in Peru include more than 3000 varieties, all of which are niche-specific, suited for a wide variety of ecosystems and climates. As Charles Darwin remarked during his journey aboard the *HMS Beagle*, "it is remarkable that the same plant should be found on the sterile mountains of Central Chile, where a drop of rain does not fall for more than six months, and within the damp forests of the southern islands" (Chapman, 2000). In my biodiversity class I learned not only differences in morphology but also which varieties are best suited for different climates, those resistant to droughts, frosts, and certain pests and diseases. For example, "bitter potatoes" are the species that can be grown in *la puna*, high altitude regions in the sierra, whereas "sweet potatoes" are grown in lower, warmer climates (MacMillan, Andean Farming for Present and Future, 1995).

Peru has a rich history and in-depth knowledge of diverse cultivation of the potato, but recently the preservation of this knowledge has become threatened, as commercial crops are starting to be substituted for native potatoes in the fields. Ironically, while I was learning the benefit of potato diversity in the classroom, I was concurrently planting only one variety of potato in our soils garden. Granted, my plot was about nine square meters, which, with the seven other classmates who were cultivating potatoes, made for only 72 square meters, less than 1/10 of a hectare. But I believe that if you're going to practice one theory in the classroom, you should practice it in the field as well.

Photo 16. A wide variety of fresh potatoes are sold in the markets in Cusco

Thus far, Peruvian farmers are by no means in danger of converting their potato system to monoculture. Now, however, they have tomatoes, cucumbers, carrots, quinoa, and other crops to replace some of the potato varieties in what often used to be a diet consisting largely of potatoes. More importantly, regional and national fresh potato markets are in danger of being replaced, in part, by the processed potato market, in which cheaply processed products such as French fries are imported from industrialized countries, namely the United States, Canada, and the Netherlands. ccIn 1992, Peru imported 83 tons of frozen French fries. In 1995, that number jumped to 1,828 tons, a 2000% increase (Maldonado, 2000). This increase is due to several factors. First, Peru was much more politically stable in 1995 than in 1992. Tourism increased in those years, thanks to the

administration of President Alberto Fujimori, and more tourism brought an increased demand for fast food options.

McDonald's, a corporation known the world over for uniformity in the taste of its products, came to Cusco the year before I got there. The only billboard advertising the fast food corporation in the city is on a hill directly across from the airport entrance. Three billboards stand there – one for McDonald's, another for Coca-Cola, and a third for Cusqueña, Cusco's home-grown beer. (Cusqueña is now owned by the Backus and Johnston brewery, which also owns Peru's other biggest beer names, including Pilsen, Cristal, Arequipeña, and San Juan. Not surprisingly, all beer in Peru tastes exactly the same.)

I know these three billboards well because for my first five months in Cusco I lived in their shadow, literally, in the apartment complexes at the foot of the same hill. Despite McDonald's looming presence in this part of Cusco, I don't know any Cusqueñan who frequents the fast food restaurant, probably in part because a hamburger costs three times more than a full lunch at most restaurants. In fact, in February and March, while Machu Picchu was closed due to flood damage, McDonald's offered a 10% discount to Cusqueñans because it couldn't support a good business with the meager trickle of tourists coming into the city. However, the picture is quite different in Lima, where eighteen McDonald's have set up shop since 1996 and enjoy a healthy support from the Limeñans. If trends in Cusco follow Lima's lead as well as McDonald's initiative to open five new restaurants in Peru every year, then the city could be looking at a very different economy in the next decade, one where more money is flowing out of the city to multi-national corporations (McDonalds). This shift clearly will affect the markets of the main products that McDonald's uses: beef, chicken, and, most importantly for my purposes here, potatoes.

In his article, "Globalization Takes Root: Potato Trade in Latin America," Maldonado warns countries he labels as current "negligible traders" that local markets soon might have to compete with

cheaper imports of processed and fresh potatoes. "Given the high levels of per capita consumption and the large numbers of low income urban consumers," he observes, "the threat of much greater imports of processed or fresh potatoes that are much cheaper than locally produced material has to be taken seriously" (227). The first objective for potato farmers in Peru is to prevent their local market being displaced by foreign imports. To accomplish this goal, Maldonado suggests marketing and selling locally preferred varieties and taking better advantage of year-long harvests.

I think Peru's potato farmers could set even larger goals, although protecting the local market is a vital step. Right now, Peru is listed under the category of "negligible trader." It would currently be impossible for Peru to compete on the same level as Latin America's relatively agriculturally industrialized countries, such as Argentina and Colombia, particularly as potato production occurs in the sierra where industrialization is even less prevalent. So it shouldn't try. But there is one thing that small-scale farmers in the Peruvian Andes have that large agricultural corporations in Colombia and Argentina do not, and that is variety – not to mention the advertising appeal of small, organic, fair-trade operations that they can provide. I've seen alpaca hats and mittens from the Andes advertised as "fair-trade" and "socially responsible" in my local Whole Foods store, so why not potatoes? Jorge Luis Quispe Velásquez, an agronomical engineer at La Molina National Agricultural University in Lima, seems to think it's possible.

Quispe, in his paper "Perspectives of Native Potato Farming in Peru," argues for the marketing potential of the native potato. In particular, he argues that this market is a good choice for farmers who might have previously been pressured to grow coca for cocaine production. Traditionally, native potatoes have been grown only as a subsistence crop because they do not have a high market price. So it isn't surprising that in the 1980s many native potato farmers opted to move to the semi-tropical valleys of the Andes and farm coca, which actually provided an income for them.

Quispe argues that the farmers can now return to farming potatoes *and* enjoy a profit from their cultivation. Several markets are available to native potatoes, the first due to the new-found popularity of *novandina* food, which uses traditional Peruvian ingredients in creative gourmet dishes. *Novandina* has grown in popularity throughout Latin America and even in the US and Europe. Indeed, a *cevicheria*, a restaurant that specializes in *ceviche*, a dish of raw fish marinated in lime juice and eaten with potatoes and *choclo* (a type of large-kernel corn specific to Peruvian cuisine), opened last year in my hometown of Louisville, Kentucky. Furthermore, tests at la Molina have supported claims of native potatoes' nutritional and medicinal properties. Certain varieties of potato were found to have high levels of antioxidants, including high levels of anthocyanins and carotenoids. The majority of these varieties showed antioxidant capacity on par with that of blueberries (Quispe Velásquez). While research is lacking in this field, the information gathered thus far has been very promising. For all these reasons, the native potato is starting to be seen as a highly marketable product.

Happily, there have been some success stories about the commercialization of the native potato in the last few years. While McDonald's is trying to lead Peru toward a blander tasting future, Lay's, another huge multi-national corporation, is doing quite the opposite. In my second semester, my daily bus ride to the Granja K'ayra took me past a billboard looking over the *Avenida de la Cultura*, Cusco's largest commercial street, which runs the length of the city from the historic central district until it turns into a highway at K'ayra at the outskirts of San Jeronimo. The billboard shows a Peruvian man holding a bundle of potatoes by their leaves, a typical Andean scene of a field and mountains behind him, and the words "*Del campo a tus manos*" underneath. This campaign from Lay's, "from the field to your hands," advertises its new product that uses native Peruvian potatoes in its chips. It is a collaborative effort among the International Potato Center (CIP) in Lima, Lay's, and highland communities to produce chips from seven varieties of native potato known for their frying

Photo 17. Lay's campaign for Peruvian potato chips

properties. Its goal is to connect the native potato with an urban consumer base. I would argue that Lay's motivation behind this campaign is not based in a sense of environmentalism or social responsibility, but rather very shrewd business decision-making.

Other examples of development projects that support the native potato are the T'ikapapa Project in Lima and the Potato Park project in Cusco, both of which are funded in part by the CIP. The T'ikapapa Project's aim, like that of the Lay's potato chip campaign, is to bring the native potato to the urban consumer through commercialization. T'ikapapa (which means "potato flower" in Quechua) is a company that packages and sells native potatoes under strict quality standards. Its aim is to bring the native potato to a wider audience but also to show that it has economic viability, for both individual producers and larger businesses (Ordinola, 2007). The Potato Park project's aim is more academic than economic, its objective being to conserve the biodiversity of the potato by creating a "living museum" of potato germplasm. The CIP provides incentive to families in the Sacred Valley of the Cusco region to cultivate varieties of native potato. This tract of land that spans

10,000 hectares and includes six communities, called the Potato Park, is farmed by 1200 Andean families (Salazar, Preserving the potato in its birthplace, 2008).

As can be seen from these examples, the push for the native potato is small but strong, and varied at that. I think this niche could provide a much-needed opportunity for the American government in Peru. I would urge the American government to support such initiatives as part of its coca eradication programs. Rather than making its focus the destruction of coca farmers' livelihoods in Tingo María, US policy should support the commercialization of native potato cultivation there so that those same farmers have an option. In this way they can shift Peruvian perspective of American government from the negative to the positive while still trying to accomplish the same mission.

IV | Conclusion

The diverse ecology and unique growing seasons that are found in Peru make it an ideal place for agriculture and natural resources. It is the place of origin of several of the world's most important crops, including the tomato and the potato. Peru also grows commercially, albeit on a small scale, a variety of crops such as Targüis cotton, grapes, quinoa, asparagus, and artichokes. Another crop of vital importance to Peru's well-being is coca, which nationally is a cherished cultural resource but internationally classified as an illegal narcotic. While Peru has made great economic advances in the tourism sector in the last few decades, its agricultural and natural resources remain a largely undeveloped economic opportunity.

Several barriers prevent Peru's expansion of commercial agriculture, two of the most important being lack of mechanization and transportation infrastructure. While Peru has fertile agricultural land in the sierra and the selva, these are less mechanized than on the coast. Agricultural production is a more labor-intensive process, in which more community members participate, as can be seen in the dairy operation in the town of Huironay. However, although there are obvious

economical drawbacks to this operation, it also creates a more closely connected community in which members share an interdependence. Huironay also illustrates the other main barrier to economically-viable agriculture in Peru, which is the lack of a developed infrastructure of transportation. In order to get milk from Huironay, businesses from Abancay and other nearby cities must drive a total of ten hours on gravel and dirt roads. This barrier is also seen in my trip to Pucallpa, when Gabriel had to travel to get not only the physical timber seeds, but local knowledge about how to grow those timber species. Obstacles such as these prevent Peru from advancing in commercial agriculture.

Other obstacles that do not have such a direct effect on agriculture include the ongoing development of gender roles and education in the country. Women are an integral part of agricultural production, particularly in the rural areas of the sierra and the selva. Due to economic development and the impact of globalization, the role that women hold in Peru is changing, and how that role changes will be a contributing factor in the future of agriculture. Furthermore, education is also vitally important to that future. While more college-aged youth are attending universities, agronomy colleges such as the one at UNSAAC attract youth who are less dedicated to the field of agriculture than in other colleges in the university that are more competitive. Free tuition in all national universities creates a moral hazard in which students can perform poorly and continuously return to the university without having to pay tuition.

Another integral component in agriculture is the management of the natural resources that sustain it. Water, which has become a stressed resource the world over, is of particular concern in Peru because almost all the country's water resources are in the sierra and selva regions, while almost all commercial agriculture takes place on the coast. While there have recently been more governmental projects, such as the Limon Dam in the north and the Majes-Sijuas II project in the

south, they are often controversial among the rural Peruvians who are most affected. Furthermore, projects like these are highly subject to changes in political authority.

Two of the most important crops in Peru are coca and the potato. Coca, which is arguably the most controversial crop in the country due to its use for cocaine production, is also an essential part of social life in many indigenous communities. Rather than punish farmers who grow coca illegally, the Peruvian government and international governments that pressure it, such as the United States, could more effectively eradicate the coca cultivated for cocaine production by offering another source of income. This source would possibly come from the cultivation of niche varieties of potato. The majority of the world consumes fewer than a dozen varieties of potato; in contrast, Peru is home to over 3000 varieties. Some of these varieties have high levels of antioxidants and flavors suitable for gourmet cooking. Programs such as Lay's "from the field to your hands" campaign and the T'ikapapa project provide economic benefit to farmers who may have been otherwise tempted by coca cultivation for the use of cocaine production. Continuing efforts such as these could not only preserve the thousands of potato varieties that are culturally important to Peru, but could provide income to some of its poorest people.

While Peru faces several obstacles to the economic growth of agriculture and natural resources, there are several opportunities for its development. While mechanization and transportation face physical and economic barriers, the quickly growing economy in Peru, as well as stable political conditions, make for a good environment to increase mechanization in the sierra and selva regions, and to continue building national and international highways like the Peru-Brazil highway currently underway. Increasing agricultural production in these regions is preferable for the management and allocation of water resources, as they are already naturally located there. Programs and projects that strive to increase the commercial production of niche crops such as potatoes can help to prevent the poor farming class in Peru from turning to the illegal cultivation of coca for

cocaine production. In these ways, Peru can take a step forward to a healthy and economically viable agricultural sector that responsibly and effectively manages its natural resources.

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